---------- CEN 4072/6070 Software Testing & Verification ----------

Quiz 3 – Spring 2017 – Solution Notes

1. a. $$\frac{\{P\}\ S\ \{I\},\quad \{I \wedge \neg b\}\ S\ \{I\},\quad (I \wedge b) \Rightarrow Q}{\{P\}\ \text{repeat S until b}\ \{Q\}}$$

b. iii. (Found ∧ Key=List[Index]) V (¬Found ∧ ∀ (1≤i≤Index) • Key≠List[i])

c. i. Proof that "Initialization" holds:

INITIALIZATION: Does {P} S {I}?

{N≥1 ∧ Index=0}
Index := Index+1
{N≥1 ∧ Index=1}
Found := (Key=List[Index])
{N≥1 ∧ Index=1) ∧ [(Found ∧ Key=List[1]) V (¬Found ∧ Key≠List[1])]}
= {N≥1 ∧ Index=1) ∧ [(Found ∧ Key=List[Index]) V (¬Found ∧ Key≠List[Index])]}
=> {[(Found ∧ Key=List[Index]) V (¬Found ∧ ∀ (1≤i≤Index) • Key≠List[i])]}
= {I}

So, {P} S {I}.

ii. Proof that "Preservation" holds:

PRESERVATION: Does {I ∧ ¬b} S {I}?

{[(Found ∧ Key=List[Index]) V (¬Found ∧ ∀ (1≤i≤Index) • Key≠List[i])]
∧ ¬(Found OR Index=N)}
= {¬Found ∧ ∀ (1≤i≤Index) • Key≠List[i] ∧ Index≠N }
Index := Index+1
{¬Found ∧ ∀ (1≤i≤Index-1) • Key≠List[i] ∧ Index-1≠N }
Found := (Key=List[Index])
{[(Found ∧ Key=List[Index]) V (¬Found ∧ ∀ (1≤i≤Index) • Key≠List[i])]
∧ Index-1≠N}
= {I ∧ Index-1≠N } => I

So, {I ∧ ¬b} S {I}.

2. a. would not (S may change the value of z.)
b. would not (S may change the value of z to an odd number)
c. would not (S may change the value of z.)
d. would not (y could be 2 and z could be 1 on termination)
e. would (if z=-5 and y≠-4 initially, Q will not hold when S terminates)

3. a. invalid (the antecedent does not guarantee that (b ∧ Q) will hold AFTER S executes)
   b. invalid (the antecedents do not guarantee that I, P, or Q will hold on termination)
   c. valid (the antecedent guarantees that Q will hold IF the loop terminates)
   d. invalid (the antecedents guarantee that S will terminate, but do NOT guarantee that the LOOP will terminate)
   e. valid (the antecedent guarantees that the loop will terminate in state Q after one iteration)